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(54) FLAME RETARDANT SCRIM

(71) We, MONSANTO COMPANY, a corporation organised under the laws of the State of Delaware, United States of America, of 800 North Lindbergh Boulevard, St. Louis, Missouri 63166, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to flame-retardant compositions useful in the treatment of fabric materials and, more particularly, to scrim which is used in the preparation of fabric materials. Specifically, the invention is directed to a flame retardant scrim and a method for rendering a scrim flame retardant.

In the preparation of textile or fabric materials, such as curtains and drapes, upholstery and floor coverings such as carpets or rugs, a scrim, i.e., a woven or nonwoven supporting member is ordinarily used as a support for the material which comprises the basis for the article being prepared. Thus, a floor covering fabric or upholstery fabric is ordinarily prepared by tufting a pile material through a scrim or by depositing nonwoven or molten materials on one or both sides of a scrim to form a laminate. In the case of carpeting, especially pile carpeting, the pile material is tufted through a scrim and is then immovably attached to the scrim by applying a binder coating of latex or resin on the under, or back, side of the scrim.

Formerly, scrim was ordinarily composed of a woven jute fabric and such fabric was passed through a tufting machine whereby looped pile elements of yarn were tufted through the scrim to form a pile of the desired

height on the upper surface of the scrim with unsecured connecting links of the yarn of the pile elements on the lower surface of the scrim. Once the scrim had been tufted throughout, a latex binder was ordinarily coated on the exposed connecting links at the lower surface to secure them to the scrim and thereby provide an integral carpet construction in which the pile elements were securely held at the desired height above the scrim. A paper scrim was often then adhered to the latex backing to add rigidity to the carpet.

Jute or other fabric scrims are not an entirely satisfactory base sheet material and an improvement over this type of scrim has long been sought by manufacturers of fabric materials.

In recent years, jute or cotton duck scrim has been replaced by thermoplastic materials such as spun nylon, polypropylene, polyethylene, polybutadiene, polystyrene and styrene copolymers, acrylic polymers and copolymers, ethylene propylene rubber, ethylene propylene diene terpolymer or other similar thermoplastic materials. Thermoplastic scrims have a number of advantages over the former cloth scrims in that the thermoplastic materials are less expensive, more easily obtainable and are easier to work with.

Unfortunately, when fabric materials based on a thermoplastic scrim are exposed to heat or flame, the thermoplastic scrim melts rapidly and spreads the flame which, in turn, causes disruption of the attached fiber or film surfaces thus greatly increasing the flammability of the material.

In view of industry-wide attempts to provide non-flammable fabric materials, it is an object of this invention to provide coating

compositions useful for imparting flame retardancy to scrims, especially scrims of thermoplastic material.

- 5 A coating composition of the invention comprises a polymer latex and a flame-retardant composition which comprises a mixture of a thermosetting resin that is a condensation product of an aldehyde and a nitrogen-containing compound or a phenol or a
10 mixture thereof, and a phosphorus-containing compound that is a phosphate ester, a phosphite ester, an ester of an organophosphonic or organopolyphosphonic acid, an ammonium polyphosphate or an ester of a phosphoroamidic acid, the coating composition containing from
15 5 to 180 parts by weight of the flame-retardant composition per 100 parts by weight of latex.

- By the use of such a coating composition in place of the latex which is ordinarily
20 applied to the scrim, fabric materials, whether woven, nonwoven or laminar, which are based on the use of a scrim as a support member, can be rendered flame retardant. The invention includes a scrim having a coating obtained
25 by applying to a scrim a coating composition of the invention and then drying; and a fabric article comprising a thus-coated scrim.

- In this manner, exposure of the fabric to flame or heat which is sufficiently high to
30 reach the combustion temperature of the fabric or scrim does not result in subsequent melting and flame propagation due to the scrim.

- By means of the present invention, thermoplastic scrims will all of their advantages over
35 previously used fabric scrims, are rendered even more advantageous and safe.

- The latices which are ordinarily used as scrim coatings for purposes of adhesion and
40 also for increasing slip and surface properties of the fabric material include acrylic latices such as poly(methyl methacrylate), ethylene/vinyl chloride/acrylic acid, poly(ethyl acrylate), poly(butyl acrylate), acrylic ester copolymers and ester/acid mixtures, polyvinyl acetate
45 latices, and other latices, for instance ethylene/vinyl chloride, ethylene/vinyl acetate, vinyl chloride homopolymers and copolymers, vinyl chloride/acrylonitrile, natural rubber, SBR rubber and carboxylated SBR rubber latices.
50

The term "latex" or "latices" is intended to include the specific materials listed above and any other latex used as a scrim coating or binder material.

- 55 The thermosetting resins which are added to the scrim coating latex are aldehyde-based thermosetting resins prepared by the reaction of aldehydes with nitrogen-containing materials such as amides, (including sulfonamides) or
60 amines, or with phenolic materials.

- 65 Illustrative nitrogen-containing compounds which are reacted with aldehydes to prepare the thermosetting resins used in the present invention include amides such as urea and substituted ureas such as monomethylolurea

and dimethylurea, sulfonamides such as *p*-toluene sulfonamide and benzene sulfonamide, amines such as melamine, 1,6-hexanediamine and hexamethylenetetraamine. Illustrative of phenolic materials which can be reacted with
70 aldehydes to form thermosetting resins useful in the present invention are phenol, bisphenol A, 4,4'-dihydroxydiphenyl methane and resorcinol.

75 Illustrative aldehydes which are reacted with the forementioned nitrogen-containing compounds or with phenols to prepare thermosetting resins include formaldehyde, acetaldehyde and terephthaldehyde.

80 It is understood that the thermosetting resins may be prepared by reacting an aldehyde with a mixture of a phenol and an amide or amine.

Phosphorus-containing compounds which can be incorporated in the scrim-coating latex, in admixture with the thermosetting resin,
85 include trialkyl phosphates, e.g., triisopropyl phosphate; triaryl phosphates, e.g., tricresyl phosphate, cresyl diphenyl phosphate, phenyl dicresyl phosphate, triphenyl phosphate, trixylyl phosphate; alkyl diaryl phosphates, e.g.,
90 nonyl dicresyl phosphate, isodecyl diphenyl phosphate, isononyl diphenyl phosphate, isononyl diphenyl phosphate, isooctyl diphenyl phosphate, isopropyl diphenyl phosphate, octyl diphenyl phosphate; dialkyl aryl phosphates, e.g., diisodecyl phenyl phosphate; alkyl diaryl and dialkyl aryl phosphates prepared from mixed C₇, C₉, C₁₁ alcohols; halogenated phosphates, e.g., tris(β -chloroethyl) phosphate, tris(2,3-dichloropropyl) phosphate, tris(2,3-dibromopropyl) phosphate; and the 2,2-bis(halomethyl) - 1,3 - propylenebis(phosphate)s disclosed in U.S. Patent No. 3,192,242; phosphonates and polyphosphonates, particularly the halogenated phosphite-phosphonates and halogenated polyphosphonates disclosed in U.S. Patent Nos. 3,014,954 and 3,014,956; polyammonium polyphosphates; and esters of phosphoroamidic acids.

110 The proportion of phosphorus-containing compound to thermosetting resin, as utilized in the present invention, may be from about 1 to 100 phr (parts by weight per hundred parts by weight of resin). Preferably from 15 to 40 phr of the phosphorus-containing compound
115 is used.

120 The proportion of the mixture of thermosetting resin and phosphorus-containing compound which is added to the scrim coating latex is preferably from 5 to 100 parts, more preferably from 15 to 50 parts by weight of the mixture per 100 parts by weight of latex.

125 In accordance with the present invention, it has been found that the admixture of thermosetting resin and phosphorus-containing compound, when added to the scrim coating latex utilized in the preparation of fabrics, builds an integral char structure upon exposure to heat or flame which effectively flame retards
130

the composite fabric material.

5 The mixture of thermosetting resin and phosphorus-containing compound can be prepared by dissolving the resin in water or water/alcohol at 50—60% solids and stirring in the phosphorus-containing compound.

10 The flame retardant compositions of this invention may also include other char formers such as any polyhydric material, e.g., erythritol, pentaerythritol or soluble starch, pigments, slip agents, coating aids and other standard compounding agents.

The following Examples illustrate specific, non-limiting embodiments of the invention.

The materials identified in the examples as "RHOPLEX" 85, "RHOPLEX" LC40, "CERECLOR" S52, "RESIMENE" 8110, "RESIMENE" 819 and "ACRYLOID" B82 are currently available from the manufacturers and have been defined herein as precisely as the applicants have been able to ascertain. ("RESIMENE" and "ACRYLOID" are Registered Trade Marks).

Example 1.

25 The following samples prepared as binders for acrylic pile carpeting on polypropylene scrims:

Ingredients	Parts by Weight							
	Sample No.							
	1	2	3	4	5	6	7	8
Acrylic resin ¹	100	100	50	100	50	50	—	—
Amine/aldehyde resin solution ²	50	50	100	—	100	100	100	100
Phosphite-phosphonate ³	—	10	25	—	—	—	—	—
Diisodecyl phenyl phosphate	—	—	—	—	—	25	25	—
Acrylic resin ⁴	—	—	—	—	—	—	50	50
Mixture ⁵					25	—	—	25

¹ "RHOPLEX" B-85

² 65% solution of "RESIMENE" 819 in water-isobutanol

³ Example 6 of U.S. Patent 3,014,956

⁴ "RHOPLEX" LC-40

⁵ Mixture of 14 parts diisodecyl phenyl phosphate, 14 parts chlorinated paraffin⁶ and 2 parts phosphite-phosphonate³

⁶ "CERECLOR" S-52 (chlorinated paraffin-52% chlorine)

30 The above samples are knife-coated (at 3, 5 and 10 mil thicknesses) on the backsides of polypropylene scrims of acrylic pile carpets. The samples are dried by heating the carpet samples in an oven.

35 The carpet samples are then subjected to test method DOC FF 2-70 which is a standard test for determining the surface flammability of small carpets and rugs. The test is commonly known as the "pill" test and is described in detail in the Federal Register, Vol. 35, No. 74, April 16, 1970.

40 Briefly, the test consists of placing a carpet sample horizontally in a frame which has a hole in its center. A small "pill" of methene-

amine (a timed burning tablet) is placed on the front or back surface of the carpet at a point over the center of the hole in the frame. The "pill" is ignited by touching a lighted match to its surface. Each test continues until (1) the flame or glow disappears or (2) the smoldering or flaming has approached within one inch of the edge of the hole in the frame. The sample is judged to "pass" if the disappearance occurs before or when the one inch distance is reached, but to "fail" if it can be seen that the smoldering or flaming would continue beyond this distance.

The results of the test on the pile surfaces

of eight samples of acrylic carpeting having polypropylene scrims coated with formulation samples 1 through 8 are summarized below:

samples having 3,5 and 10 mil thicknesses of binder on the polypropylene scrims.

5 Sample 1 2 3 4 5 6 7
Fail Pass Pass Fail Pass Pass Pass

Example 2.

The following latices are prepared as flame retardant binders for spun-bonded polypropylene scrims:

10

The results of the tests are the same on

Parts by Weight

Ingredients	Sample No.					
	1	2	3	4	5	6
Acrylic resin ¹	100	100	100	100	100	100
Amine/aldehyde (65%) ²	30	30	30	30	30	—
Polyammonium polyphosphate	5	—	—	15	—	15
Dipentaerythritol ³	10	10	—	—	10	10
Polyphosphonate ⁴	5	10	15	—	15	15

¹ "RHOPLEX"

² 65% solution of "RESIMENE" 819 in water-isobutanol

³ Char-former

15 Results of the "pill" test on the scrim side of the acrylic carpet are summarized below:

Sample 1 2 3 4 5 6
Pass Pass Pass Pass Pass Fail

Example 3.

The following latices are prepared as flame retardant binders for spun-bonded polypropylene scrims:

20

Parts by Weight

Ingredients	Sample No.				
	1	2	3	4	5
Acrylic resin ¹	50	50	50	50	50
Methyl ethyl ketone	50	50	50	50	50
Pentaerythritol ²	10	15	10	5	10
Polyammonium polyphosphate	5	5	10	10	10
Polyphosphonate ³	5	—	—	5	10
Amine/aldehyde resin ⁴	10	10	10	5	15

¹ "ACRYLOID" B-82

² Char-former

³ Example 6 of U.S. Patent No. 3,014,956

⁴ "RESIMENE" 810

Results of the "pill" test on a spun-bonded polypropylene scrim are summarized below:

Sample	1	2	3	4	5
	Pass	Pass	Pass	Pass	Pass

5 WHAT WE CLAIM IS:—

1. A coating composition comprising a polymer latex and a flame-retardant composition which comprises a mixture of a thermosetting resin that is a condensation product of an aldehyde and a nitrogen-containing compound or a phenol or a mixture thereof, and a phosphorus-containing compound that is a phosphate ester, a phosphite ester, an ester of an organophosphonic or organopolyphosphonic acid, an ammonium polyphosphate or an ester of a phosphoroamidic acid, the coating composition containing from 5 to 180 parts by weight of the flame-retardant composition per 100 parts by weight of latex.
2. A coating composition according to Claim 1 in which the polymer of the latex is a polymer or copolymer of an alkyl acrylate or methacrylate, polyvinyl acetate, an ethylene/vinyl acetate copolymer, a vinyl chloride homopolymer or copolymer, or a rubber.
3. A coating composition according to either of Claims 1 and 2 wherein the thermosetting resin is a urea/formaldehyde, melamine/formaldehyde or phenol/formaldehyde resin.
4. A coating composition according to any of Claims 1 to 3 wherein the phosphorus-containing compound is a trialkyl phosphate, a triaryl phosphate, an alkyl diaryl phosphate, a dialkyl aryl phosphate, or a tri(haloalkyl) phosphate.
5. A coating composition according to any

of Claims 1 to 4 that contains 15 to 40 parts by weight of the phosphorus-containing compound per 100 parts by weight of thermosetting resin.

6. A coating composition according to any of Claims 1 to 5 which contains a further char-forming material.

7. A coating composition according to any of Claims 1 to 6 containing from 5 to 100 parts by weight of the flame-retardant composition per 100 parts by weight of latex.

8. A coating composition according to Claim 7 containing from 15 to 50 parts by weight of the flame-retardant composition per 100 parts by weight of latex.

9. A coating composition according to Claim 1 substantially as described in any of Examples 1 to 3.

10. A scrim obtained by applying to a scrim a coating composition according to any of Claims 1 to 6, then drying.

11. A scrim according to Claim 10 wherein the material of the scrim is a thermoplastic.

12. A scrim obtained by applying to a thermoplastic scrim a coating composition to any of Claims 7 to 9, then drying.

13. A fabric article comprising a coated scrim according to any of Claims 10 to 12.

14. A article according to Claim 13 that is a floor covering or an upholstery fabric.

15. An article according to Claim 13 substantially as described in any of Examples 1 to 3.

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